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$$\therefore\ a_1-a_2+a_3-a_4+\ldots\ldots+a_{\frac{n-3}{2}}-a_{\frac{n-1}{2}}=1.$$

(2) When $\frac{n-1}{2}$ is odd.

$$\therefore\ a_1+a_3+a_5+\ldots\ldots+a_{\frac{n-1}{2}}=2(\cos\frac{\pi}{n}+\cos\frac{3\pi}{n}+\cos\frac{5\pi}{n}+\ldots\ldots$$

$$+\cos\frac{(n-1)\pi}{2n})=\sin\frac{(n+1)\pi}{2n}/\sin\frac{\pi}{n}$$

$$=\sin\left(\frac{\pi}{2}+\frac{\pi}{2n}\right)/\sin\frac{\pi}{n}=\tfrac{1}{2}\text{cosec}\frac{\pi}{2n}\ldots\ldots\ldots\ldots(3).$$

$$a_2+a_4+a_6+\ldots\ldots+a_{\frac{n-3}{2}}=2(\cos\frac{2\pi}{n}+\cos\frac{4\pi}{n}+\cos\frac{6\pi}{n}+\ldots.+\cos\frac{(n-3)\pi}{2n})$$

$$=\frac{2\cos[(n+1)\pi/4n]\sin[(n-3)\pi/4n]}{\sin(\pi/n)}=\frac{2\cos[\frac{1}{4}\pi+(\pi/4n)]\sin[\frac{1}{4}\pi-(3\pi/4n)]}{\sin(\pi/n)}$$

$$+\frac{[\cos(n/4n)-\sin(\pi/4n)][\cos(3\pi/4n)-\sin(3\pi/4n)]}{\sin(\pi/n)}=\frac{\cos(\pi/2n)-\sin(\pi/n)}{\sin(\pi/n)}$$

$$=\tfrac{1}{2}\text{cosec}(\pi/2n)-1.\ \ldots\ldots\ldots.(4).$$

$$\therefore\ a_1-a_2+a_3-a_4+\ldots\ldots-a_{\frac{n-3}{2}}+a_{\frac{n-1}{2}}=1.$$

$$\therefore\ OA_1-OA_2+OA_3-OA_4+\ \ldots..\pm OA_{\frac{n-1}{2}}=1.$$

70. Proposed by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy in Ohio University, Athens, Ohio.

Prove that the locus of the center of the circle which passes through the vertex of a parabola and through its intersections with a normal chord is the parabola $2y^2=ax-a^2$, the equation to the given parabola being $y^2=4ax$.

Solution by the PROPOSER.

The circles being $(x-m)^2+(y-n)^2=r^2$..........................(1),

and passing through the vertex of $y^2=4ax$............. ....(2),

becomes $x^2-2mx+y^2-2ny=0$....................................(3).

Now the extremities of the normal chord being $(at_1{}^2,\ 2at_1)$, $(at_2{}^2,\ 2at_2)$, normal at the former point, we have

$$a^2t_1{}^4-2mt_1{}^2+4a^2t_1{}^2-4nat_1=0\ldots\ldots\ldots\ldots\ldots\ldots(4),$$

$$\text{and } a^2t_2{}^4-2mt_2{}^2+4a^2t_2{}^2-4nat_2=0\ldots\ldots\ldots\ldots\ldots\ldots(5).$$

Divide these by at_1, at_2 respectively, and take one result from the other and divide by t_1-t_2; then

$$a(t_1^3+t_1^2t_2+t_1t_2^2)=2mt_1-4at_1 \quad\text{(6).}$$

Divide (4) by at_1 and take (6) from the result; then

$$at_1t_2(t_1+t_2)=-4n \quad\text{(7).}$$

But it can be shown that $t_1+t_2=-(2/t_1)$ ……(8).

Substituting in (7) and reducing, $t_2=(2n/a)=-t_1-(2/t_1)$ ……(9),

which gives $t_1=\dfrac{-n+\sqrt{n^2-2a^2}}{a}$ ……(10).

(10) in (6) gives $2n^2=am-a^2$ ……(11),

the required locus of center of (1).

Also solved by *F. M. McGAW*.

[NOTE. Solution of Problen 69 will appear in the next issue. Editor.]

MECHANICS.

Conducted by B. F. FINKEL, Springfield, Mo. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

44. Proposed by O. W. ANTHONY, M. Sc., Professor of Mathematics, Columbian University, Washington, D. C.

There is a triangle whose sides repulse a center of force within the triangle with an intensity that varies inversely as the distance of the center of force from each point of the sides of the triangle. What the position of equilibrium of the center ?

Solution by HENRY HEATON, M. Sc., Atlantic, Iowa.

Put p=altitude of the triangle upon the side a as base, s=distance of center of force from the side a, x=distance of any point of side a from the vertex B, y=distance of any point of the side b from the vertex C, and z=distance of any point of the side c from the vertex B.

The force exerted by any portion dx of the side a resolved perpendicular to it, is $msdx$ where m is an arbitrary constant depending on the intensity of the force. The forces exerted by portions dy and dz of the sides b and c are respectively $m[s-(b/p)y]dy$ and $m[s-(c/p)z]dz$. For equilibrium we have